The Great Workshop of Science

Story of Treenails

ROMANTIC literature has handed down many words, like oakum, timbers—usually in the act of being shivered—and planks, which are accepted as the conventional composite parts of shipbuilding. Common sense has, however, always added coherence to these details by the imagined use of nails of copper or steel, and it provides something of a shock to find that in this late day ships are fastened together with wood. L. C. Everard tells the story of "treenails," as they are called, in the August number of "Munsey's":

"Tremendous wooden nails, called treenails—'trunnels,' in shipbuilders' parlance—are still used to fasten together the planking, frames and ceiling of wooden ships. The planking is the outer shell of the hull, the ceiling the inner, and the frames form the skeleton inclosed between the inner and outer shells. The wooden nails have to be of considerable size to reach through all three thicknesses. In many instances they are as much as three feet long and as large in diameter as one and one-half inches.

"A hole is bored with an auger through planking, frame and ceiling and the treenail is driven home in this with a wooden mallet. The men who do the work acquire a muscular development like a blacksmith's in the process, for the treenail is usually turned larger than the auger hole—sometimes as much as one-sixteenth of an inch—and has to be whacked pretty hard to drive it in to the head.

"Whittier, who well knew the work of the New England shipbuilder, says in a familiar poem:

Lay rib to rib and beam to beam,
And drive the treenails free.

"Unless the nail is of the best quality and of straight grain it is likely to 'broom,' or split, under the hammering. There is danger of this even with the best material, and two ways have been suggested for minimizing the danger. The outer half of the hole is bored with one auger and the inner half with an auger one-sixteenth of an inch smaller. The treenail is tapered one-sixteenth of an inch from head to point, or it is turned in two drifts, the half at the entering end just the size of the outer part of the auger hole and the half at the head one-sixteenth larger, each portion of the nail thus being one-sixteenth larger than the hole it must ultimately go into. A nail made in this form can be simply pushed in half the way and then hammered home.

"After the nails are driven the heads are sawed off even with the planking, a split is made in the middle of each head and a wedge is inserted. Some shipbuilders also wrap the treenails near the head in oakum before driving them home.

"The wedges used nowadays are the full width of the nail, are driven in two inches and are about one-quarter of an inch thick where they are cut off. Wedges are driven so as to spread the nail against the end grain of the planking, because if they were driven the other way the planking might be split.

"There is something else besides the drift and the wedging of the head to hold the treenail tight. When the boat is put into the water the nail swells. The auger hole enlarges, too; but here a curious property of wood comes into play to clamp the treenail more firmly in its place. Wood shrinks and swells, with reduction or increase in its moisture content, very slightly lengthwise of the lumber, so that the difference in the auger hole is very slight; but it shrinks or swells considerably the other way, so that the seasoned treenail becomes appreciably enlarged when it is soaked, and by pressing against the fibres of the planking increases immensely its holding power.

"If you look at the side of a wooden ship you will see no signs of these tremendous wooden nails. It looks all smooth, and no doubt many a landsman supposes that the planking is nailed on just like the siding of a house. The reason for this smoothness is that after the wedging has all been done the outside of the ship is carefully adzed and the ends of the treenails are smoothed off even with the planking; then a coat of paint makes the ship look as much like one piece as a canoe."

Toads Are Doing Their Bit, Too

IF YOU happen to find a toad in your war garden, don't interfere with him. He is a patriot. His work is beneficent, and he knows precisely what he is about.

He eats flies, moths, worms, bugs and all sorts of noxious insects that prey on plants. He works at high speed, too, despite his apparent inertia. A biological authority says a toad has been observed to snap up 128 flies in half an hour. Try catching that many flies yourself, and you will gain respect for the humble and homely batrachian.

The same authority estimates that if cutworms do a cent's worth of damage apiece, a single toad may be worth $20 a season merely through his anti-cutworm activities.

So do not kill the little reptile. He may be ugly, but he has a kind heart and a disposition to do his bit toward saving democracy. If you have not a family of toads in your garden it will pay to import some and guard them zealously from small boys and lawnmowers.—From *The Aberdeen American.*

Making Newspapers for the Blind

Here is shown in operation the machine which makes maps for the blind. Almost any sort of raised embossing can be produced by this method

Photo supplied by the Publishers Photo Service.

NEWSPAPER MAKING for the blind—a very different process from that of printing for those who can see—is described in "Scientific Mechanics." The publishing of "Ziegler's Magazine," the blind man's paper, is a complicated task, as the following exposition suggests:

"In printing newspapers for the blind, and illustrating them, several highly ingenious machines are employed. It is a much more complicated affair to produce the curious raised letters or signs than to print in the ordinary way, but the work is carried on by marvellous labor-saving devices, much the same as in a regular printing office. There are typesetting machines, typewriters, machines for producing the curious blind pictures or illustrations, and printing presses. No newspaper man or printer would feel at home, however, surrounded by this unfamiliar looking machinery.

"The blind man's newspaper is not printed, of course, in any familiar sense of the word. Its letters or hieroglyphics have length, breadth and height, as well, and it is this third dimension that complicates the work. It should be called a punched or pressed, rather than a printed, page. Every detail of the typed word, as well as the illustrations, must be raised high enough above the surface of the sheet to be distinctly felt by the sensitive fingers of the blind reader. The actual work of printing is necessarily much slower than in the case of ordinary printing. The same ingenuity which has served to save so much time and labor in turning out a newspaper has revolutionized the process in the blind man's paper office.

"There is at present but one publication in America issued for blind readers, but the invention of this ingenious time-saving machinery opens great possibilities. The blind man's paper, entitled "Ziegler's Magazine," is not for sale on the newsstands, nor is it hawked about by the newsboys. It is a combination of magazine and newspaper, and has the distinction of being the only magazine which is sent through the mails free of postage. Its raised letters and illustrations give it a somewhat unwieldy appearance, although its weight is no greater for that reason. To render the letters as distinct as possible to the fingers of its readers, a special heavy paper is used.

"The typesetting machine employed in such work does not, as a matter of fact, set type in the ordinary sense. It is a highly ingenious device which makes it possible to punch the letters in a sheet of copper. The machine is operated by a keyboard like a typewriter. The letters are those of the Braille alphabet, which forms the A, B, C of every blind man's education. Such a typesetting machine is, of course, much simpler than the linotype, that sets the type, casts the line and redistributes the letters. It is important that the operator on the blind man's machine be very accurate, since a mistake in a letter means the wrong shaped hole in the copper sheet, which cannot be erased. It will be noticed that the keyboard of the typesetting machine has but ten keys. This does not mean that the Braille alphabet has but ten letters. The operator presses down the keys in combinations of two or more at a time, thus producing the various letters and forms of the blind alphabet.

"The forms produced by the typesetting machines are produced in pairs. Later, when they are placed on the cylinder of the printing press, the two come together exactly overlapping, so that they intermesh. Each projection fits into a corresponding aperture exactly as the two faces of an embossing stamp. One is in relief, the other intaglio. These copper plates, which correspond to the type cylinder used in ordinary newspaper printing, are locked on the cylinders of a specially constructed printing press. With each revolution of the cylinders the two copper plates of each page come together and intermesh with absolute accuracy. To print the page a sheet of manila paper is fed into the press. As it passes between the cylinders the pressure, which is considerable, forces the paper into the openings in the copper plate, and a moment later it comes out raised, exactly reproducing the copper plates. The raised letters have been neatly stamped into the sheet.

"The printing office of the blind man's paper is full of surprises. Any one familiar with printing offices is amazed at the wonderful cleanliness of the shop. The presses and machinery look more or less familiar, and the roar of the machinery has a friendly sound, but there the similarity ends. The transformation is due to the fact that the blind man's paper is printed without ink. The blind, of course, read their alphabet by the sense of touch alone. The printing press has no ink rollers or plates. The proverbial printer's devil works with clean hands. The shop is as clean as any business office.

"The blind man's paper is actually illustrated to the satisfaction of its readers. It contains maps and diagrams illustrating the text, reproduced, of course, in relief, so that it may be read by the fingers of the blind. To print such a map a copper plate, or, rather, two of them, is stamped by means of dies and the raised lines are printed exactly as the letters.

"An ingenious machine has been designed for the work. It consists of eight dies which, when used singly or in combination, produce every form of raised embossing required in making these maps and diagrams. The plate for printing a full page map is shown in an accompanying illustration. The map, it will be seen, is that of the North Pole regions, showing the Arctic Circle and the parallels of latitude, with the outlines of Greenland and the northern continents. The water, instead of being indicated by blue shading, as in an ordinary map, has been worked over with a series of regular projections. The boundary lines of the land are indicated by dotted lines. The Arctic Circle and the parallels of latitude are continuous lines, which may be readily distinguished. The names of the bodies of water and of the land are printed in the Braille alphabet. A long caption beneath the cut explains the map. Even the route followed by Peary is indicated by a line of crosses which cannot be mistaken for the other markings. These plates are mounted on the rollers of the press like the others and printed in the same way.

"As might be expected, the blind man's newspaper carries a large proportion of the war news and illustrations.

"The water area in maps is indicated by a series of dots, while the land is left smooth. The boundaries of the various countries are made clear to the blind reader by a raised line. The names of all the countries and the principal bodies of water are printed in raised characters."

Out of the Many

ACCORDING to the Continental editor of "The London Mail," many ideas have been submitted to the inventions department of the Ministry of Munitions. One in ten may be useful; the others are old or impracticable.

"A frequent suggestion made to the department is to attach a searchlight to an anti-aircraft gun, project the light on the object and shoot along the beam. But shells will not follow the path of light. A plan put forward to prevent polished railway lines shining at night was that the last coach of the last train should drip blacking on them!

"Proposals include a shell containing gravel to lay a pathway over the mud; and another containing irritant powder or sticky substance to hamper machine guns. By one scheme two guns are to be fired simultaneously, the shot being connected by a chain to which bombs and incendiary devices are to be attached. It is clear that variations in powder or differences in wear of the gun would make it impossible to predict which direction the device would take.

"Another favorite subject dismissed as mechanically unsound is the 'relay shell,' a shell acting as a small gun discharged in midair and expelling a small inner shell, the object being to obtain an increased range. The explanation is that a shell in flight does not point directly along its trajectory, but makes an uncertain angle with it, so that accuracy of aim would be impossible.

"All kinds of substances have been proposed as fuel. One man had a powder, he said, which, mixed with water, turned it into motor spirit, but he declined to disclose the powder's composition.

"Electricity, many folk believe, can achieve anything. It is proposed to electrocute the enemy; to interfere with magnetos or compasses of aircraft: to explode ammunition dumps.

"Magnetism is proposed for attracting and bringing down enemy aircraft—or repelling them—and for diverting falling bombs.

"Suggestions are frequently received in connection with colored searchlights, but color, it is found, cannot be imparted to a beam without reducing its intrinsic brilliancy. The most wonderful proposition of all is that of a 'black beam' for obscuring the moon.

"Among miscellaneous projects are: One to cool machine guns by placing them in a vacuum jacket, the inventor forgetting that thermos flasks keep things hot as well as cold; a second to petrify the German soldiers by squirting cement over them, and a third to throw live wire cables among the enemy by means of rockets.

"Inventions relating to the production of munitions have been far more practicable than any others. Mostly they have been put forward by those actually engaged in the work, who in many cases have themselves put their ideas into practice."

The Man Who Invented the Peanut

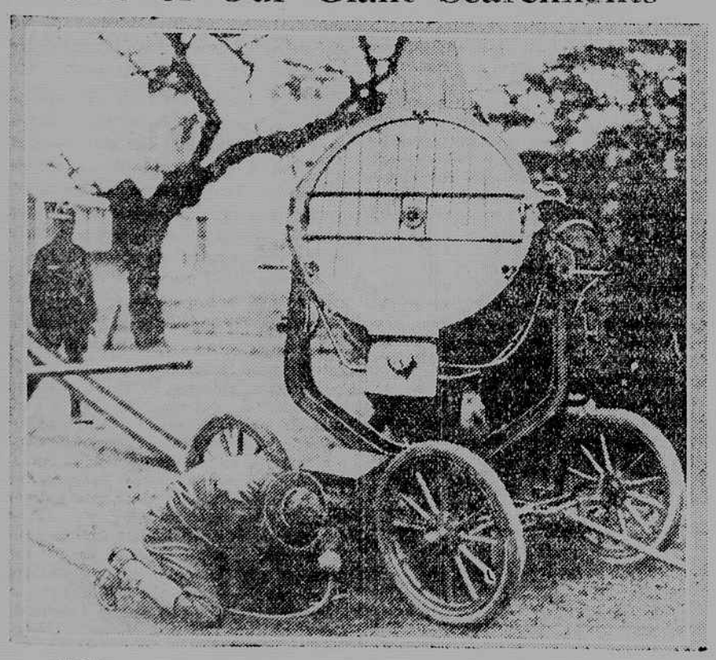
THE peanut has not always been with us, as some of the men past fifty can testify. Indeed, according to "The Pittsburgh Dispatch," that delicacy was popularized by a man who died this summer:

"There died the other day at his home in Norfolk, Va., Thomas B. Rowland, aged ninety-three, 'the father of the goober.' The present generation of peanut lovers probably presumes that we have always had the peanut, yet men not much past middle age can recall when peanuts were eaten almost by stealth, when they were yet to become a national food familiar on every ball ground and circus stand. In those days you could buy a quart for a nickel—another illustration of the H. C. of L. in these times.

"Rowland returned to his native state after the war to find a land of desolation. He entered the produce business, and one day had the idea that there was a possibility in the peanut, a popular comestible among the Southern natives. He tried to interest some of his Northern customers, who were dubious and reported peanuts were hard to sell. Rowland, according to the story, hired the loudest voiced vender he could find, equipped him with a push-cart and a roaster, and the cry of 'Red roasted peanuts, five cents a cup!' startled Northern passersby. Curiosity triumphed and the peanut came into its own. The Italians took them up, and soon peanut stands were a familiar part of every street scene in the centres of population. One of the Italian venders, Petroni by name, had the enterprise to interview P. T. Barnum and secure a concession from him for the sale of 'goobers' at the circus, the first appearance of the henceforth indispensable feature of the grandstand and the bleachers.

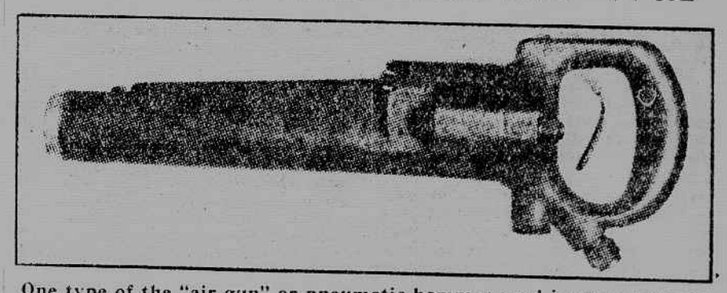
"Rowland lived to see the peanut, once 'hard to sell,' being raised by the millions of bushels and sold at prices that he never would have thought possible, extolled by dieticians, and manufactured into a variety of foods which have given it the dignity of a place on the menu and among the staple crops of the country."

One of Our Giant Searchlights



THE mobile anti-aircraft section of the Engineer Corps, stationed at Washington Barracks, Washington, has a battery of powerful searchlights which are of invaluable aid in searching out enemy 'planes at night. Daily drills are held and the men are becoming experts in quickly rigging out their equipment. This picture gives a good idea of the size of these searchlights. —Committee on Public Information, from *International*

Gun That Will Win the War



One type of the "air gun" or pneumatic hammer used in ship construction for riveting and for a variety of other purposes

THE gun that will win the war is not the "Big Bertha" that has been shelling Paris, nor yet the Allied invention which pierces the armor of the German tanks, but the air gun or pneumatic hammer which rivets our ships, according to "World's Work," from which the following appreciation of that weapon is taken:

"Early in the war we heard a great deal about the German 42-centimetre gun. Then the English 'four-point-seven' anti-aircraft gun attracted attention. Lately we have read of the remarkable performances of the French three-inch gun, the wonderful little 'seventy-five.' Now the German gun that has been shelling Paris at a range of seventy-five miles has added a new chapter to the record of Schrecklichkeit.

"But the gun that will win the war is none of these. It is a weapon of which America has countless batteries in action. Its bore is only an inch and an eighth, a mere toy besides the 'seventy-five,' but it has a range of 3,000 miles. Hats off to the 'air gun'!

'That is what every shipyard worker calls the tool that made possible the biggest splash in history, when nearly 100 ships, aggregating nearly half a million tons, slipped off the ways of American shipyards on the Fourth of July. Without the pneumatic hammer the building of a tenth part of these ships would have been impossible.

"The air gun is taking its place, too, alongside the polo mallet, the tennis racquet and the brassie as an implement of sport. The most exciting international sporting event of recent years is the contest, now in full swing, for the riveting championship of the world. Three times in as many months the title has crossed the Atlantic; it has been held in England, in Scotland and in Ireland, where it now remains; it has been held on the Atlantic Coast and on the Great Lakes, with Pacific ports as close contenders. Down on the Gulf there are riveting gangs that hope some day to bring the championship to that section.

"The world's record, as this is written, is held by John Moir, of Belfast, whose certified performance of 11,209 standard rivets in the floors of a ship in a nine-hour day elicited a cablegram of congratulation from Director General Charles M. Schwab of the Emergency Fleet Corporation.

"The importance of rivets is obvious when it is realized that even a comparatively small steel freighter, say 5,500 deadweight tons, has more than half a million rivets in its construction; a 10,000 ton ship will have nearly a million rivets. Most of these must be water-tight, many of them oil-tight as well. Rivets hold together the plates and beams that form the keel, the floors and the frames of the ship; they fasten the shell plates to each other and to the frames; they secure the inner sheathing or 'ceiling' and the bulkheads that divide the water-tight compartments; they fasten the deck beams in place and the decks to the beams; they attach the hatch coamings and make the upper works secure; from boilers and shaft tunnels to bridge and cro'nest, the building of the ship depends upon rivets, rivets, and nothing but rivets."

A Weather Glass

THE following directions for making a weather glass are contributed to "The Electrical Experimenter" by G. E. Spitzmiller:

"A test tube about 10 inches long and ¾ inch in diameter is fastened to a base or hung up by a wire. In this test tube are put 2 drams of camphor, ½ dram of potassium nitrate, ½ dram of ammonium chloride, 2 ounces of pure alcohol, 2 ounces of water. If the ingredients do not mix easily tube should be put in warm water or shaken thoroughly. After a cork is put in the tube it is ready for work.

"Following is the weather which the changes in the liquid denote:

"Clear liquid—Bright weather.

"Crystals at bottom—Thick air, frost in winter.

"Dim liquid—Rain.

"Dim liquid with small stars—Thunderstorms.

"Large flakes—Heavy air, overcast sky; snow in winter.

"Threads in upper part—Windy weather.

"Small dots—Damp weather, fog.

"Rising flakes which remain high—Wind in upper air.

"Small stars in winter on bright, clear, sunny days—Snow in a day or two."

More Light on Shell Shock

SHELL SHOCK is a thing that came upon a world unprepared. Days and nights of uninterrupted death, shattering explosions, mud and water and hunger and sleeplessness—all the concomitants of modern fighting—have caused this peculiar lapse of brain and nerves which for want of a better name is called shell shock. Victims of it were first put in asylums for the insane in England, until it was discovered that their symptoms were not of the usual recognizable kind. Only recently have scientists been able to discover some of the fundamental effects of the displacement of quantities of air, the brain lesions that result from tremendous explosions in the atmosphere. M. Allen Starr, emeritus professor of neurology, writes illuminatingly of the subject in the August number of "Scribner's Magazine":

"In a number of fatal cases recorded by F. W. Mott small hemorrhages, microscopic in size, hundreds in number, have been found scattered irregularly through the brain. These destroy not only nerve cells but also the nerve fibres, which carry the messages from cell to cell and enable the processes of association of ideas and memories to go on in the mind. The mechanism of thinking is in this way completely thrown out of gear. Such little clots may in time during life be absorbed, like the hemorrhage caused by a bruise, so that their existence is not necessarily fatal and does not permanently incapacitate the individual.

"In other cases changes in the cells of the brain are produced which are known to follow continued emotional strain or long-continued sleeplessness in animals. If a rabbit is kept awake for one hundred hours it dies of exhaustion in spite of feeding. If a rat is frightened to death it shows the same brain condition found in the rabbit. These changes in brain conditions found in the rabbit are characteristic of exhaustion. The brain cell, like a grape, has a skin and an internal framework filled in with gelatinous material. When it is put to work this material is used up until at last the framework and skin are empty, like a dried raisin. If the work ceases while a little gelatine remains nature may provide a new supply through the blood and fill the skin again. But if the substance is all used up no regeneration is possible. Now, under emotional strain or sleeplessness or exhaustion the same changes occur that we see after work, and hence we believe that as a basis of shell shock in some cases there is a state of disintegration in the brain cells of greater or less degree.

"There is still another explanation, which happily applies to very many of the cases. If one receives a sudden blow upon the head a state known as concussion results, in which for a time all the faculties are suspended. But later on they return and the effect passes off. It seems as if fear could cause a sort of mental concussion. Now if one regards mental activity as dependent on the flow of thought, or the play of consciousness, along the thousands of nerve fibres within the brain, and if mental shock suspends for a time the passage of those nerve impulses, we can readily imagine a suspension of nerve action which is temporary and not due to actual disease. Many regard these nerve impulses as electrical in nature, and we may imagine a grounding of the nerves or an arrest of conductivity such as puts our telephones out in a thunderstorm. Then orderly thought, clear, conscious perception, voluntary activity may be suspended for a time—but return when the storm is over. These are analogies only, but they help one to picture the state of the mind and the brain in shell shock.

"It has been known for a long time that sudden changes in atmospheric pressure produce startling effects upon the nervous system thorough the blood. Just as the removal of the cork from a bottle of champagne sets free bubbles of gas in the fluid, so the sudden removal of atmospheric pressure from the body sets free bubbles of gas in the blood; and these, by acting as plugs in the finer vessels, cut off the brain and nervous system from the blood supply and thus derange their action. Now it has been shown that the explosion of large shells causes an atmospheric pressure of ten tons to the square yard on bodies within fifty feet, and this is succeeded at once by a corresponding decrease of pressure. Thus the secondary effect of the explosion of a shell is to cause gases to form in the blood which may paralyze or even kill. This is the explanation of deaths in the trenches without evidence of external injury, and is also accepted as the underlying cause of some cases of shell shock."